Committee on Resources

Subcommittee on Fisheries Conservation, Wildlife and Oceans

Witness Statement

Testimony before the House Subcommittee on

Fisheries Conservation, Wildlife, and Oceans

On

H.R. 2903: Coral Reef Conservation and Restoration Act of 1999

By

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My name is John C. Ogden. I am Director of the Florida Institute of Oceanography and Professor of Biology at the University of South Florida. I have spent my research and teaching career of 30 years working on coral reefs all over the world and introducing students and the public to their beauty and endless fascination and their importance to science and society. I had a role in the design of the International Coral Reef Initiative and the implementation of its major activity, the Global Coral Reef Monitoring Network. I am the ex-president of the International Society for Reef Studies, a 750-member organization of scientists, resources managers and conservationists from over 50 countries dedicated to the scientific understanding and protection of coral reefs. Presently, Florida Institute of Oceanography administers and leverages funding for numerous research and monitoring projects on coral reefs in the Florida Keys National Marine Sanctuary and the greater Caribbean Sea.

I am honored to be here to testify in support of H.R. 2903 and the related Senate Bills 725 and 1253. I am acutely conscious that we have a narrow window of time in which to turn the present extraordinary high profile of coral reefs into actions that will assure their sustainable use and enjoyment by future generations.

Why do we care about the fate of coral reefs?

A little more than a century and a half ago, a young U.S. geologist by the name of James Dwight Dana, following by only a few years in the footsteps of Charles Darwin, joined the U.S. Exploring Expedition, also known as the Wilkes Expedition. During this pioneering circumnavigation of the globe, Dana was attracted to the beauty and biological diversity of coral reefs and the mystery of the ability of corals to build massive reefs. Dana extended Darwin's observations from HMS Beagle in the Indian Ocean on the origin of coral atolls. Their often prickly relationship extended over a lifetime of correspondence on the nuances of coral reef origin and structure. The collections and observations of the Wilkes Expedition and of Dana led to the creation of our National Museum of Natural History. Dana's book, *Corals and Coral Islands*, and the work of generations of scientists who followed, link our current fascination and concern with coral reefs firmly to that of these pioneers.

Two public issues very much in the forefront of environmental science and policy involve coral reefs: the manifest human disturbance and destruction of global biodiversity and global climate change. Reefs are our most biologically diverse marine ecosystem-- the "rainforests" of the sea-- and contain representatives of nearly every major group of animals and plants found on the planet. For example, coral reefs contain 25% of the known species of marine fishes. As reefs are accessible, grow in clear tropical waters, and can be relatively easily observed and manipulated, coral reefs have provided fundamental scientific information to understand the functioning of marine ecosystems.

In 1838, when Dana joined the Wilkes Expedition, the global human population was approximately 1.2 billion, about 20% of the 6 billion mark reached this month. Half of the global population lives in the coastal zone and through population growth and changing demographics coastal populations are growing explosively. Many coral reefs grow on coastal shelves and are intimately linked to the land and protected from its inimical influences by intervening coastal forests, mangroves and seagrasses which act as protective buffers. The reef in turn protects the coastal zone from the open ocean, permitting the shoreward systems to exist.

Almost everything we do on land works its way into the sea and becomes a stress on reefs, particularly destabilization of the soil leading to erosion, dredging, and point- and non-point sources of sewage pollution. Decades of research have shown that sewage pollution, called nutrification, is particularly damaging, causing algal blooms which cloud the clear tropical waters and fertilizing the growth of bottom living plants which overgrow and kill corals and interfere with the growth of juveniles.

Nutrification may also stress corals, possibly making them susceptible to diseases. In the greater Caribbean there are as many as 10 coral diseases recognizable in the field by unique symptoms that have devastated some coral populations. Two of the most important reef building species, staghorn and elkhorn coral, have declined precipitously throughout their range-- up to 95% loss in some areas. In spite of this documented virulence, we have no idea of the cause(s). Other diseases have recently been described in the Pacific.

While we do not have an accepted global estimate, it is fair to say that every coral reef in the world accessible to relentlessly expanding coastal human populations is significantly degraded and many have been destroyed. Even remote coral atolls far from coastal regions have not escaped. Powerful fishing vessels can range widely and can significantly damage a reef in only a few visits.

Reefs are important to economies. U.S. coral reef ecosystems in Hawaii and the Florida Keys alone produce more than $2 billion annually. Elsewhere in the Third World, reefs are the shining hope of future economic development through eco-tourism and appropriately scaled local industries.

Reef fishes are 10% of the world's total kill of approximately 100 million tons of marine fishes. In many countries, reef fish protein goes primarily to the poor. In the U.S. it is estimated that over half of our federally managed fish species depend upon reefs at some point in their life and commercial catches alone are valued at over $100 million annually. Reef-dependent recreational fisheries are worth many times more.

Recently we have become aware of the extraordinary sensitivity of reefs to overfishing of the large size classes of predators and herbivorous fishes. Removal of these causes destabilization of lower trophic levels on the reef and often the displacement of corals. Reefs are also vulnerable to destructive fishing practices including the use of explosives and poisons and other methods, such as *muro-ami*, which damage reef structure. Reefs cannot sustain export fisheries as their very diversity means that there are fewer numbers and less productivity of commercially valuable species than in less diverse temperate regions.

The National Cancer Institute is screening numerous promising anti-inflammation, anti-cancer, and anti-AIDS compounds from the world's coral reefs. We may expect that the evolutionary fine-tuning of biological relationships which allowed the discovery of many pharmacological compounds from tropical forests will be similarly significant in drug discovery on coral reefs.

With a total global area of only 600,000 km^2, less than 1% of the global ocean, coral reefs do not participate significantly in ocean-atmosphere exchange. However, they are widely thought to be harbingers of global climate change in the oceans through "bleaching." Bleaching involves disturbance of the physiological relationship between corals and their symbiotic single-celled plants, called zooxanthellae, which live within the coral animal cells and provide much of the color of the coral.

In response to unusually elevated and/or prolonged seasonal high temperatures, often in synergy with increased ultra-violet solar radiation, the plant cells are expelled, causing the coral to turn white, or bleach. Normally corals will recover their plant cells after bleaching, but prolonged high temperatures can cause stress, failure of reproduction, and even death.

Coral bleaching was first reported in the early 1980's and has increased in frequency, geographic spread, and intensity since then. Indeed, the global coral bleaching event of 1997-98 is widely believed to have been the most significant and damaging in history. Whether or not coral bleaching is a sign that global warming has affected the oceans is the subject of intensive debate and has stimulated much research interest on the part of NOAA and other scientific agencies.

In summary, coral reefs have a large public constituency, perhaps more than any other part of the ocean. This is a powerful inducement to action and a powerful lever to effect change. At the same time our reefs have shown through decades of research that they are an ecological "house of cards," very sensitive to direct human disturbance and also to global climate change. Loss of our coral reefs can have a significant global economic impact, but more importantly, loss of this most diverse of marine ecosystems deprives future generations of the wonder and enjoyment of nature's finest handiwork.

What must we do to sustain coral reefs?

We must support and expand the coral reef management and conservation strategies currently in place in our nation's marine sanctuaries, national parks, and reserves.

There are two aspects of management critical to the sustainability of coral reefs in any location: (1) control of land-use and runoff; and, (2) the use of zoning to separate potentially conflicting human activities on the water. Implementation of these management tools requires basic information on the distribution of reef resources. We need to implement a program of mapping using our superb tools of satellite, remote and *in situ* data collection and geographic information systems to help us plan our management. Mapping should include existing protected areas and also adjacent regions where spawning areas and unique reef features may be located.

Where possible coral reef protected areas should be co-located with managed and protected drainage basins which run from the ridge-top to the reef. This concept was practiced by the ancient Hawaiians. Where land development occurs, it must be scaled to the available area so that runoff may be controlled by the use of well-known techniques including holding ponds and retaining basins, and vegetated cover. This will help to prevent sediments and nutrients from clouding coastal waters and stressing corals. Efficient sewage disposal systems must be designed and installed that treat sewage effluent to a level that does not fertilize algal blooms in the water column or on the reef. The gradual nutrification of coastal waters is one of the most potentially damaging human disturbances to coral reefs.

Control of sewage pollution and runoff can work. For example, Kaneohe Bay on the north shore of Oahu was devastated by sewage and overgrown by "green bubble algae." It has recovered by the application of common sense management including moving the sewage outfall to deep water and controlling non-point pollution sources. Another well-known case study in Palawan, Philippines demonstrated the positive economic trade-off between a logging operation which would have destroyed local reefs through runoff of sediments and coral reef tourism. Coral reefs were shown to have by far the greater economic potential.

On land, we have used zoning to separate potentially conflicting human activities. Our uses of the coastal ocean for commerce, recreation, and travel are indistinguishable from our uses of the land and zoning will be our most effective tool to avoid conflicts, although to date zoning has rarely been used. The Great Barrier Reef Marine Park and the Florida Keys Sanctuary are notable exceptions.

Coral reef protected areas zoned for multiple uses and containing fishing and collecting prohibition zones, also called *no-take marine reserves*, *ecological reserves*, and *marine wilderness areas,* have proven to be the most controversial type of zoning as they deny access to what was formerly an "ocean common,"open to all but the responsibility to none. For example, in reaction to a campaign of commercial and recreational fishers, the ecological reserves of the Florida Keys National Marine Sanctuary-- at 2700 nm^2 one of our largest and most complex attempts to manage a significant coral reef-- were gradually reduced from 5 reserves at 20% of the sanctuary area to one at 0.05% of the area in the final plan. Nevertheless, in all parts of our nation and in the world marine reserves have captured the imagination of fishers, conservationists, the public, and scientists who have seen the failure of traditional fisheries management and see in marine reserves a simple and effective way of managing marine resources.

Marine reserves of almost any size placed within a coral reef area will lead to the development of more fishes of larger size in 3 to 5 years. This has been the result wherever in the world such reserves have been implemented and enforced. Reserves can also enhance reef development. A recent survey of sites in the CARICOMP network of Caribbean marine laboratories, parks, and reserves showed that those sites within parks and reserves where control of fishing access was the only management tactic were the only sites where coral cover was stable or had increased over the last 10 years.

However, the key question is how many reserves of what size and configuration must be placed within a larger area zoned for multiple uses in order to sustain the full range of coral reef biodiversity. There has been a great deal of speculation about this question and the figure of 20% arises repeatedly. The truth is that in some places this may be enough, but in others insufficient. Nobody knows for sure, but, given our problems of coral reef decline and loss, we have to start somewhere. By monitoring the results over time reserve areas may be reconfigured within the regional context of other management schemes.

We must understand that U.S. coral reefs are linked to those of other nations through ocean currents and that sustaining them will involve international cooperation in research, management, and conservation.

While our parks and reserves are a necessary first step, the appropriate geographic scale of conservation is the eco-region, broadly defined as the region of distribution of organisms critical to coral reefs where they are in reproductive contact. Over 80% of coral reef species have a planktonic larval life of from several weeks to over a year, during which they may be carried long distances and link distant reef locations. This nation's agencies and institutions have developed superb capabilities to track and model the ocean currents that link distant regions. Understanding these currents is as basic to our efforts to our understanding and management of coral reefs as the chart.

For example, the Florida lobster fishery, with a remarkably stable and valuable catch of 6 million pounds per year, is probably sustained by larvae that originate "upstream" in the Caribbean Sea. On the other hand, satellite tracked drifters in the Florida Keys have shown that seasonal and permanent oceanic current gyres and counter-currents can entrain locally produced larvae such that their adult populations may be self-sustaining. Information on the origin and fate of marine larvae carried by ocean currents is critical to every aspect of coral reef resources management.

The World Wildlife Fund has defined over 60 global marine eco-regions, including many coral reef areas, in which international cooperation in the siting of marine reserves and in the control of land-based sources of pollution will provide an important first step in the conservation of coral reefs.

We must monitor our coral reefs and those within contiguous eco-regions over the long-term using the tools of modern oceanography.

Just as tracking of our personal health requires repeated visits to the doctor where our vital signs are compared with a baseline, so our assessment of the status and trends of our coral reefs requires repeat visits and long-term monitoring of key parameters. A great deal of effort has gone in to defining monitoring programs and these should be supported and expanded. In the Florida Keys, the SEAKEYS program is based on a network of 7 automated, satellite-linked, *in situ* monitoring stations attached to the historic lighthouses of the reef tract. Over 7 years the SEAKEYS system has documented many oceanographic events that shape coral reefs including as hurricanes, summer high temperature events, winter cold fronts, harmful algal blooms, and the 1993 flooding of the Mississippi River which sent low salinity water over the Keys reefs. We have a rapidly growing technical capability in automated monitoring and remote sensing and the coral reef can be a target region in which methods may be tested that will have application in all ocean regions.

Monitoring of our coral reefs should be linked to regional and global international efforts such as the CARICOMP network of Caribbean marine laboratories, parks, and reserves and the Global Coral Reef Monitoring Network.

We must support basic research in corals and coral reefs.

Two examples will illustrate the general and continuing need for basic research. It has been suggested that corals are harbingers of global warming in the ocean, but we do not know enough about the physiological relationship between corals and their symbiotic algae to fully interpret the potentially critical signal of coral bleaching. Coral diseases are an emerging problem on coral reefs and have devastated whole regions, yet we know these diseases only by field characteristics. Field monitoring must be backed up by coral pathology at a center which can serve all of our coral reef regions as well as international ones. The center would not only help in the identification of potential pathogenic conditions, but also work on the cause and spread of the diseases leading to effective intervention.

This country has created a basic research capability second to none. Much of this work has been applied to our increasingly important and effective attempts to manage our environment. There are myriad of other areas where basic research will provide fundamental information not only about corals and coral reefs but also about how our world works.

Restoration of damaged coral reefs should be done within the context of long-term management, especially of water quality.

In many parts of the world, such as American Samoa, coral reefs are threatened by grounded and abandoned ships which physically destroy reefs, leak toxic materials, and which are an eyesore in areas dependent upon tourism. Reef management must include appropriate penalties for intentionally or accidentally grounded ships so that they may be removed.

Reefs damaged by ship groundings can be restored with concrete and engineering but sometimes our efforts are driven more by legalities than by common sense. For example, the intricate and expensive operations to restore reefs damaged by ship groundings in the Florida Keys grow out of the legal requirement that fines collected from ship owners for reef damage can only be used to repair that particular damage. Reef restoration will only be effective if some of the funds can be used on measures to improve water quality so that coral reproduction and recruitment will occur on the restored reef forms. There is no question that reefs are resilient and have enormous capability to recover from damage if water quality is good.

What does the future look like?

Precisely because reefs have survived the cataclysms of millions of years of a changing global environment, I am optimistic for their future. In almost every region where there is a problem, reasonable people backed by the best available information and their own common sense know what to do. What is needed is a national program of coral reef management, science, and conservation and the "political will" to apply this understanding to conserve reefs and their resources.

Specific Comments on H.R. 2903 and related Senate Bills

Most of the coral reefs of the U.S. are located in the Pacific. I support the provisions in S. 1253 to split the funding between the Atlantic and the Pacific. Coral reefs are spread over a much larger region in the Pacific and human disturbance is not as concentrated. Hawaii, for example, is ready to take the basic first critical steps of reef assessment and mapping as are other regions.

There have been notable advances in Florida and the U.S. Caribbean in basic coral reef management and the region is ready to take significant steps to incorporate our most modern technology to understand reefs and linkages across the whole eco-region.

I urge you to consider the importance and complexity of a national coral reef program and to compromise on the $20 million annual budget figure of S. 1253. This will also demonstrate a commitment that will enhance our ability to generate matching funds from the private sector and from non-governmental organizations.

I also suggest flexibility in matching fund requirements for grants based on the tremendous differences in capacity across our reef regions.

Finally, the U.S. Coral Reef Task Force has demonstrated exemplary inter-agency cooperation in the discussions of the critical situation of our nation's coral reefs. I hope that the budgets of other key agencies--particularly Interior, EPA, and the Navy-- can be enhanced to leverage these NOAA funds into a truly significant and cooperative national program.

Thank you for the opportunity to speak to you today.

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